Notes on south Indian Hepaticae—2[1,2] The genus *Herberta* Gray

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(*With twenty-nine text-figures*)
[*Continued from Vol. 72*(2): 406]

Introduction

The genus *Herberta* is represented in the Hepatic flora of South India by four species, namely *H. pinnata, H. capense, H. nilgerriensis* and *H. sanguinea.* Illustrated taxonomic account and critical distinguishing features of the first three species have been given. The observations recorded are entirely based on a collection of plants made by Rev. P. Pfleiderer from south Indian territory as well as on the type specimens obtained from Stephani Herbarium, Geneva.

Our first paper of this series deals with the description of one species each of *Trichocolea* and *Notoscyphus* (Udar & Srivastava 1975). In the present paper detailed and critical taxonomic description of three South Indian species of the genus *Herberta* has been given.

The genus *Herberta* is considered to be one of the important and most isolated member of the leafy liverworts. Previously it was treated under the family Ptilidiaceae (subfamily Ptilidioideae)—a group generally regarded to be primitive. Müller (1948, 1954; emend Fulford & Hatcher 1958) segregated this genus into a distinct family Herbertaceae.

Significant features of this genus are the presence of isophylly, deeply bifid leaves, absence of scattered rhizoids on the stem, intercalary branching, thick-walled cells in the multilayered cortex, peculiar position of antheridia in the axil of bracteoles, multistratose capsule wall and absence of any specialized body of any kind for asexual reproduction.

According to Evans (1917) the rhizoids, although very rare, in this taxon, originate normally from the cells at the base of the underleaves. Apart from underleaves, rhizoids have also been known to occur on the lateral leaves as well. In most of the cases where rhizoids are known, they originate from the abaxial face of the leaf lobes (Schuster 1957). Schuster remarked: " Such a position for the rhizoids is extremely rare in Hepaticae, recurring chiefly in taxa with potentially caducous leaves." However, at times rhizoids have also been shown to originate from the adaxial face of the leaves.

The intercalary branching with thick-walled cells in the multilayered cortex is considered to be primitive. The position of antheridia in the axil of bracteoles is rare in any other liverwort genus except *Mastigophora,* a member of the same family Ptilidiaceae (Schuster

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1957). Although there is no specialized bodies of any type for asexual reproduction, isolated regenerants or propagulae have been found on the adaxial faces of the leaf lobes. The asexual reproduction has been described in some species by fragmentation (as in *H. tenuis*: Schuster 1957) as well as by regenerants produced from the leaves (as in *H. remotiusculifolia*: Horikawa 1934).

The genus *Herberta* is represented in India by 16 species (Montagne 1842; Stephani 1909, 1922; Herzog 1939; Pande & Udar 1950 and Miller 1965).

Herzog (1939) merely named three new species (all nomen nudum) of the genus from Sikkim Himalayas without giving their diagnoses. These are: "*Herberta lonchobasis* Herz. *et* Nich. n. sp. in Herb-Tsomgo Lake, leg. Troll., *Herberta nicholsonii* Herz. n. sp. in Herb-Tsomgo Lake, leg. Troll., *Herberta mastigophoroides* Herz. *et* Nich. in Herb-Darjeeling, leg. Kerston ".

Recently Miller (1965), in a monograph on the genus, has published the diagnoses of the above species under the name *H. lonchobasis* Miller and *H. mastigophoroides* Miller from the original collection of Herzog (1939) and treated *H. nicholsonii* as a synonym of *H. lonchobasis*. He has also given a new name *H. darjeelingensis* Miller for *H. gracile* St.

The Eastern Himalayas predominate in number of species while the Western Himalayas has only one species (*H. kurzii*) of this genus (Stephani 1909). Four species, namely *H. pinnata, H. capense, H. nilgerriensis* and *H. sanguinea* have been known to occur in south India (Montagne 1842; Stephani 1909; Pande & Udar 1950).

In his revision of the genus from Tropical Pacific and Asia, Miller (1965) has included almost all the species originally reported from various localities in India except *H. capense*. Of these only three south Indian species (*H. pinnata, H. nilgerriensis* and *H. sanguinea*) have been described. These, except *H. sanguinea*, have been considerably amplified with relevant illustrations in the present paper and the diagnostic features have been critically discussed. An account of *H. capense* not included by Miller has also been given.

Miller (1965) recognized five sections under the genus *Herberta* on the basis of the primitive and advanced characters of the plants. According to him "... a little differentiated vitta is relatively primitive... and a long and sharply defined one is advanced.....; a shallow sinus is less advanced than a deep one; straight leaves are less advanced than curved; an expanded basal disc composed mainly of isodiametric cells is advanced over a basal disc about equally composed of isodiametric and vitta cells; a reduced basal disc composed almost entirely of vitta is also advanced; and elongate cylindrical tip cells apparently derived from vitta initials are advanced over short cylindrical tip cells derived from laminal initial cells."

His five sections of the genus *Herberta* are as follows (species listed under each section are those represented in Indian flora):

1. *Fissiherberta*: 'Leaves bifid 1/2 or less, vitta indistinct, leaf insertion nearly transverse', e.g. *H. darjeelingensis* (*H. gracile*): Eastern Himalayas.

2. *Herberta*: 'Leaves bifid 3/5 or more, leaf segments straight to curved with segments subequal or the antical reduced, leaf tips acute or attenuate by means of short cylindrical cells derived from the lamina', e.g. *H. nilgerriensis, H. pinnata* and *H. sanguinea*: South India; *H. lonchobasis, H. dicrana H. longifissa, H. sikkimensis, H. fleischeri* and *H. fragilis*: Eastern Himalayas.

3. *Cirriherberta*: 'Leaves bifid 3/5 or more,

leaf segments slender, circinate, with the postical segment reduced.' None of the Indian species described so far comes under this category.

4. *Dilatiherberta*: 'Leaves bifid 1/2 or less, vitta distinct, leaf insertion oblique', e.g. *H. himalayana*: Eastern Himalayas, *H. kurzii*: Western Himalayas. The discovery of *H. himalayana* from North America (Miller 1968) makes it a "North American Himalayan disjunct which parallels the distribution of *Takakia* in part, adds more evidence for a common flora, or at least a well-established migration track, between the mountains of Asia and those of North America."

5. *Piloherberta*: 'Leaves bifid 3/5 or more, leaf segments straight to curved with segments subequal or the antical reduced, leaf tips attenuate by means of elongate cylindrical cells derived from the vitta', e.g. *H. mastigophoroides* and *H. wichurae*: Eastern Himalayas.

According to him (Miller 1965, p. 301): ".... sect. *Fissiherberta,* or something like it, was the ancient progenitor of the genus as we know it and that sect. *Herberta* developed more recently under conditions highly conducive to retention of genetic aberrations in unsaturated biomes."

He further remarked that " Section *Herberta* was ancestral stock for *Cirriherberta, Dilatiherberta,* and *Piloherberta,* and intergrades into each to the extent that some species could be justifiably placed in either section."

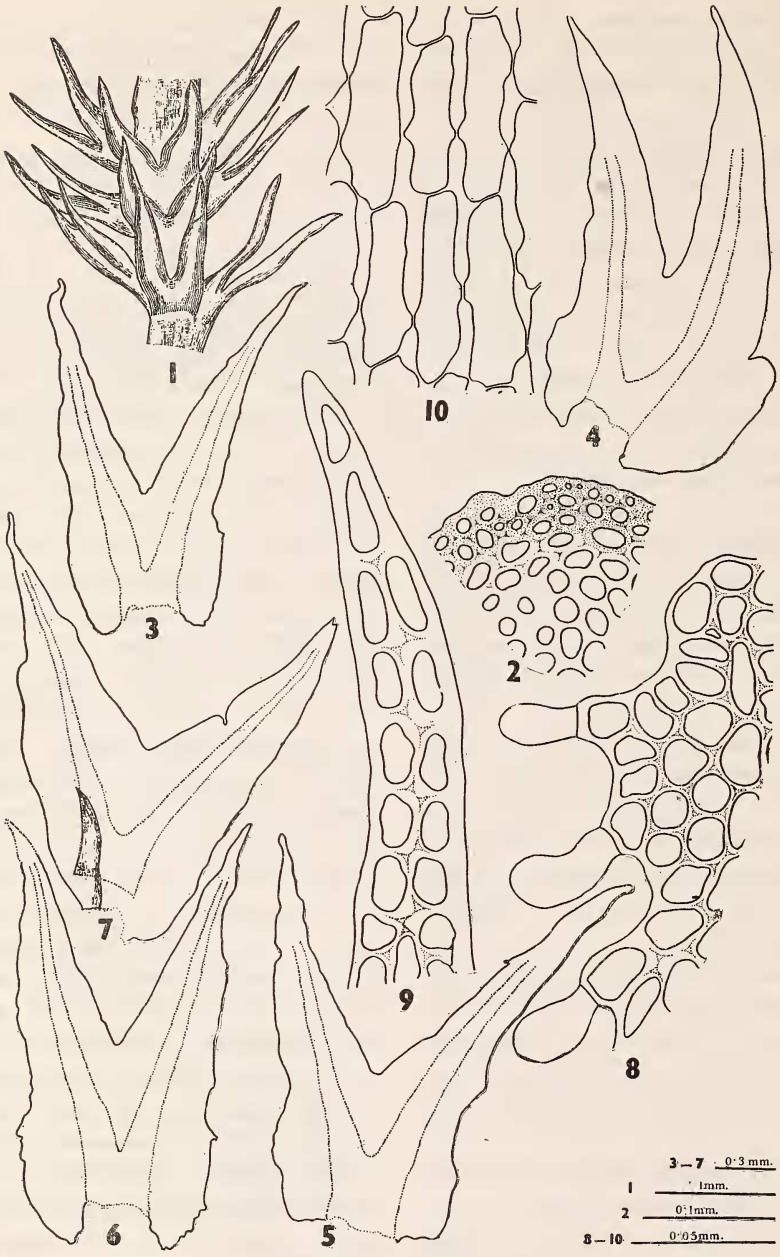
The materials, on which the present investigation is based, were collected by Rev. P. Pfleiderer of Esslingen (Germany) from Western Ghats (South India) and preserved dry in packets. The type specimens of *H. pinnata, H. nilgirriensis* and *H. capense* obtained from Stephani Herbarium, Conservatoire et Jardin Botanique, Geneve, have also been investigated. Only sterile plants were represented in the collections.

Taxonomic Description

Herberta Gray

Herberta S.F. Gray., Nat. Arr. Brit. Pl. 1p 705 (1821). *Schisma* Dum. Common Bot., p. 114 (1822). *Mastigophora* Sect. *Schisma* Nees, Naturgesch. eur. Leb. 3p. 573 (1838). *Sendtnera* Nees, in Gottsche, Lindenberg u. Nees, Syn. Hep., p. 238 (1844).

Gametophyte generally large and robust, reddish brown, consisting of prostrate rhizomatous base which gives off generally intercalary aerial branches. Rhizome distinguished from stem only by the presence of small and distant leaves which may be sometimes absent. Stem stiff, straight and branched, internally differentiated into an outer cortical and inner medullary zone, cortical zone 2-3 cell layers thick, cells with considerably thickened walls having small lumen, trigones distinct, middle or medullary zone composed of comparatively larger cells with larger lumen and less thickened walls. Leaves single, bifid, arranged in three rows, identical in shape and size, transversely or obliquely inserted on the stem, larger on the main stem, smaller on branches, apices acute to acuminate, curved or straight with divisions equal or unequal in size, unistratose, composed of isodiametric cells, smaller towards margin, gradually becoming larger and elongated towards centre (vitta), walls considerably thickened with bulging trigones; lateral leaves similar to those of the underleaves except in size; underleaves usually smaller than the lateral leaves; vitta undivided at the base, forking somewhere below the bifurcations of the leaves, each division of the vitta extends up to or a little below the apices of the bifurcated leaves; vitta



Figs. 1-10. *Herberta pinnata* (St.) Miller.
Fig. 1. A portion of stem with 3 rows of leaves. Fig. 2. Cross section of stem. Figs. 3-5. Leaves. Figs. 6, 7. Underleaves. Fig. 8. Marginal cells of leaf with slime papillae. Fig. 9. Vitta cells. Fig. 10. Cells towards apex of the leaf.

cells more elongated at the base, shortened towards the apex.

KEY TO THE SOUTH INDIAN SPECIES

1. Plants robust and large in size, leaves 2-2.75 × 0.5-1.0 mm, divisions of the leaves divergent, may or may not be curved 2
   2. Leaves 1/3 or more bifid, divisions about 1.4 × 0.5 mm, slightly curved, ending in 2-4 superimposed cells; at the distance of about 0.3 mm from the apex the divisions are 5-6 cells wide, slime papillae stalked and easily met with in majority of leaves .. *H. pinnata*
   2. Leaves 2/5-1/2 bifid, divisions 1.5 × 0.38 mm, highly curved, ending in 4-10 superimposed cells; at the distance of about 0.3 mm from the apex the divisions are 4-5 cells wide, slime papillae sessile and rarely present in some leaves ..... *H. capense*
1. Plants medium in size, leaves 0.75-1.9 × 0.5-0.8 mm, divisions of the leaves slightly convergent, curved or almost straight 3
   3. Leaves bifid 1/3-1/2, leaves and underleaves more or less of the same size, about 0.75-1.0 × 0.5 mm ..... *H. nilgerriensis*
   3. Leaves bifid about 3/5, leaves and underleaves usually not of the same size, underleaves 1.4-1.7 × 0.6-0.7 mm .. H. *sanguinea*

Herberta pinnata (St.) Miller

Herberta pinnata (St.) Miller, J. Hattori bot. Lab. *28*:299, 1965. *Schisma pinnata* St., Spec. Hepaticarum *6*:361, 1922.

(Figs. 1-10)

Plants dark brown, robust; stem 54-74 mm long, erect, profusely pinnately branched, 0.3 mm in diameter, cortical cells 2-3 layered with thickened walls, middle cells comparatively large with less thickened walls; branching closely pinnate, branches up to 30 mm long. Leaves in 3 rows, lateral leaves 2-2.75 × 0.5-0.9 mm on the main axis, 0.7 × 0.21 mm on branches, bifid approximately 1/3, divisions lanceolate up to 1.4 × 0.52 mm, usually straight, sometimes slightly curved and divergent, acute to acuminate, ending with 2-4 superimposed cells; leaf divisions 5-6 cells wide at the distance of about 0.3 mm below the apex; slime papillae stalked, present at the margins of the undivided portion of the leaf. Underleaves slightly smaller than the leaves, about 2-2.5 × 0.9-1.0 mm, divisions long and straight; marginal cells towards the base more or less isodiametric, *c.* 9-14.4 μ in diam., cells in between the vitta and the margin *c.* 19.2-38.4 × 9.6-12.0 μ, cells towards apex *c.* 38.4 × 9.6 μ. Undivided vitta at the base nearly 326.4 × 316.8 μ, bifid 1/3 or 1/2 of the basal undivided part of the leaf; cells of the vitta *c.* 57.6 × 14.4 μ at the base. Fertile specimens not available.

Locality. Dodabetta (*c.* 8000 ft), Nilgirries (South India). *Legit*: Rev. P. Pfleiderer.

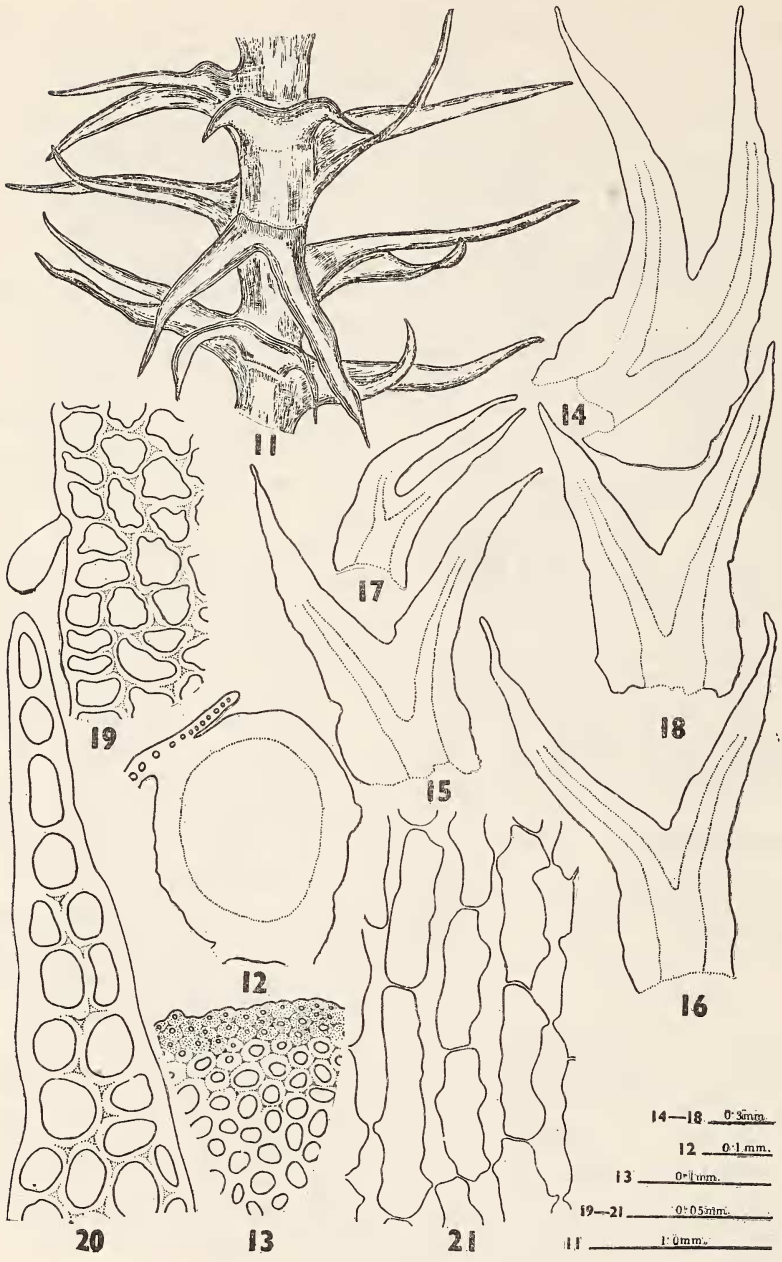
Specimens examined.

1. G 012125: Fondation Stephani; Herbarium E. Levier Original; 6140 *Schisma pinnatum*, Montis Nilgiri India S.W., Dodabetta 8765p-2670 M 12 Sep. 1907: legit Rev. B. Luthi.
2. Lucknow University Hepatic Herbarium: *Legit*: Pfleiderer. *Loc.* Dodabetta (South India).

Herberta pinnata can be easily distinguished by the presence of closely pinnate branching and the large and robust size of the plant. Leaves are symmetrical with well developed and clearly defined vitta (Figs. 3-7). Majority of the leaves show slime papillae which are stalked (Fig. 8). They are usually present at the margins of the undivided basal portion of the leaf. Miller (1965) has however reported the presence of subsessile slime papillae in this species.

Herberta capense (St.) Sim.

Herberta capense (St.) Sim., Trans. Royal Soc. S. Afr. XV: 75, 1926. *Schisma capense* St., Spec.



Figs. 11-21. *Herberta capense* (St.) Sim.

Fig. 11. A portion of stem with 3 rows of leaves. Fig. 12. Cross section of stem. Fig. 13. Magnified sketch of the same. Figs. 14-16. Leaves of the main stem. Fig. 17. Branch leaf. Fig. 18. Underleaf. Fig. 19 Marginal cells of the leaf. Fig. 20. Cells towards apex of the leaf. Fig. 21. Vitta cells.

Hepaticarum 4:6, 1909. *Chalubinskia africana* Lehm., according to Sim.

(Figs. 11-21)

Plants dark brown, 30-50 mm long, about 0.27 mm in diameter, scarcely branched, branches about 11 mm or so long. Leaves in 3 rows, lateral leaves 2/5-1/2 bifid, 2-2.5 × 0.75-1.0 mm, divisions lanceolate and unequal, 1.5 × 0.38 mm, mostly curved with acute to acuminate apices ending in 4-10 superimposed cells; leaf divisions 4-5 cells wide at the distance of about 0.3 mm below the apex. Slime papillae sessile. Underleaves similar to those of the leaves, *c.* 1.5 -2.5 × 0.5-0.75 mm. Marginal cells of both leaves and underleaves *c.* 9.6-19.2 μ in diameter, cells between the margin and the vitta *c.* 18.8 × 9.6 μ, cells towards the apex *c.* 38.4 × 9.6 μ. Vitta 1/3 bifid of the basal undivided part of the leaf, undivided vitta at the base 163.2-172 × 249.6-297.6 μ, cells of the vitta at the base *c.* 57.6-86.4 × 9.6-14.6 μ. Fertile specimens not available.

Locality. Kudremukh (South India). *Legit*: Rev. P. Pfleiderer.

Specimens examined.

1. G 012123: Herbier Stephani: *Schisma capense,* Von Lehman.
2. Lucknow University Hepatic Herbarium, *Schisma capense. Legit.* Pfleiderer. *Loc.* Kudremukh (South India).

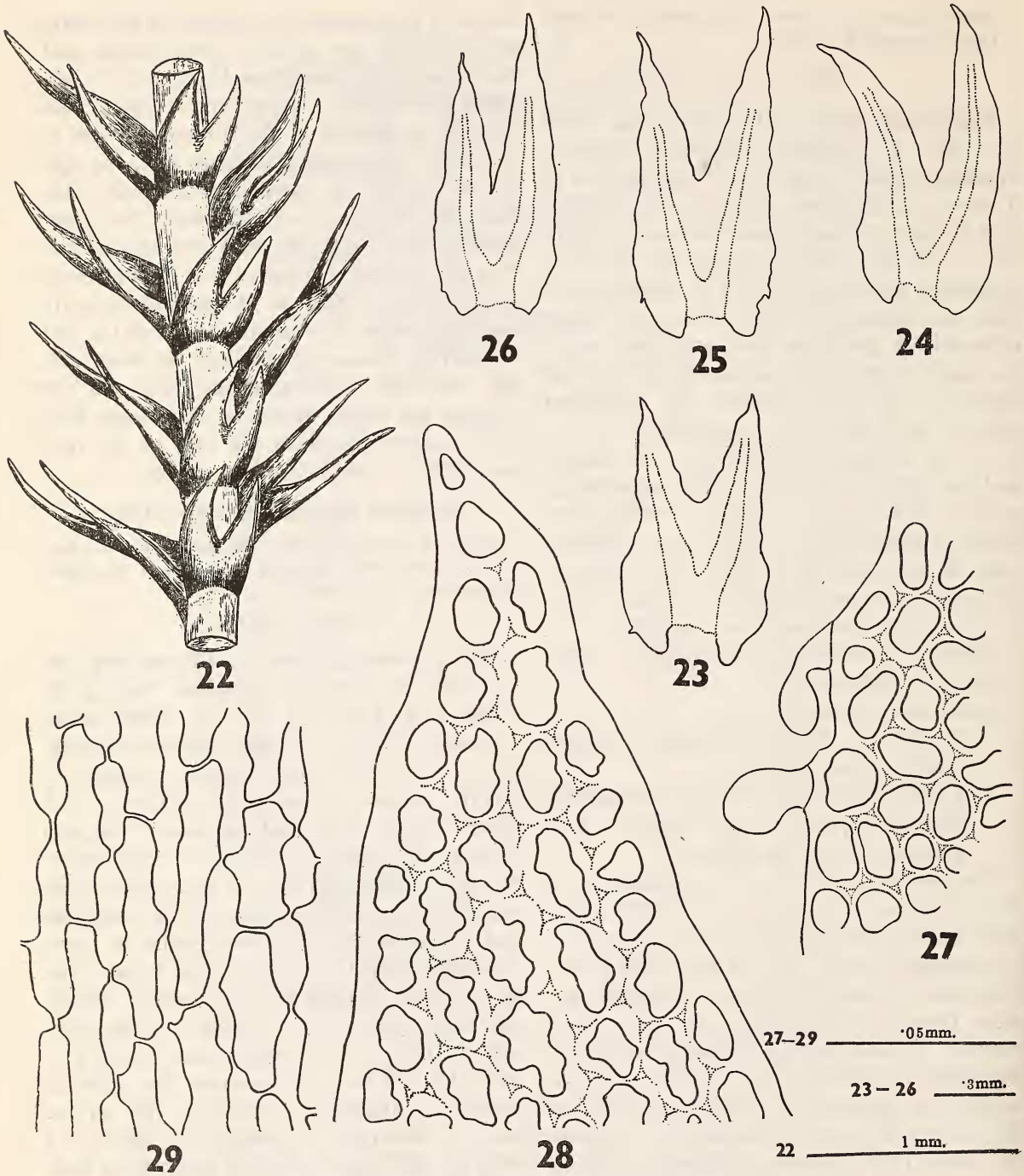
The present species *H. capense* resembles *H. pinnata* in the colour and texture of the plant, stem anatomy, attachment of leaves and also in the marginal cells of the leaf except for a little difference in their size in both the species. Besides these similarities there are fairly large number of distinguishing characters which are significant in delimiting the two taxa. For example, the characteristic profuse branching of the stem in *H. pinnata* is absent in *H. capense,* the leaves of *H. capense* are broader than the leaves in *H. pinnata,* the divisions of the leaves in *H. capense* are greatly curved, longer and less broader in contrast to *H. pinnata.* In addition the number of superimposed apical cells is more in number in the former and less in the latter. At the same distance from the apices of the leaf, *H. capense* is 5-6 cells wide while *H. pinnata* is 4-5 cells wide. The slime papillae are present in both the species but they are stalked and easily met in the leaves of *H. pinnata,* while in *H. capense* they are rare and sessile. The marginal cells of the leaf in the two species are nearly of the same size, but, the cells in between the vitta and the margins are larger in size in *H. pinnata* than in *H. capense.* Similarly the cells of the vitta also differ in size in the two species.

Herberta nilgerriensis (St.) Miller

Herberta nigerriensis (St.) Miller, J. Hattori bot. Lab. *28*:299, 1965. *Schisma nilgerriensis* St., Spec. Hepaticarum *4*:28, 1909.

(Figs. 22-29)

Plants yellowish brown, *c.* 57 mm long and 0.29 mm in diameter, branches few up to 6 mm long. Leaves in 3 rows, lateral leaves 1/2 bifid 0.75-1.0 × 0.5 mm, divisions convergent, *c.* 0.6 × 0.25 mm, unequal, straight or slightly curved, apices acute ending in 1-3 superimposed cells; leaf divisions 7-9 cells wide at the distance of about 0.3 mm below the apex. Sometimes one or two sessile slime papillae occur at the margins of the undivided part of the leaf. Underleaves similar in shape and about of the same size as the leaves, divisions short unequal and converging. Marginal cells of the leaf *c.* 9.6-16.8 μ in diameter, cells in between the margin and the vitta *c.* 19.2-23.2 × 9.6 μ, cells towards the apices *c.* 9.6-12 μ in diameter. Undivided vitta at the base *c.* 96.0-115.0 × 144-153.6 μ about 1/2 bifid of the basal undivided part of the leaf;



Figs. 22-29. *Herberta nilgerriensis* (St.) Miller.
Fig. 22. A portion of stem with 3 rows of leaves. Figs. 23, 24. Leaves. Figs. 25, 26. Underleaves. Fig. 27. Marginal cells of the leaf. Fig. 28. Cells towards apex of the leaf. Fig. 29. Vitta cells.

basal cells of the vitta *c.* 48.0-57.6 × 16.8 μ. Fertile specimens not available.

Locality. Nilgerries. *Legit.* Perottot.

Specimen examined.

1. G 012124: Herb. J. Cardot: No. 89: *Schisma nilgherriensis* St., Hindoustan Nilgherries. *Leg.* Perottot.

The present investigation is based entirely on the specimens obtained from Stephani Herbarium. *Herberta nilgerriensis* differs apparently from *H. pinnata* and *H. capense* in the overall size of the plant as well as in the size and shape of the leaves. This species is smaller in size than the other two species. In addition the divisions of the leaf in *H. nilgerriensis* are almost straight and convergent whereas in *H. capense* and *H. pinnata* the divisions of the leaves are apparently divergent and more or less curved. Greatly curved leaves as commonly found in *H. capense* are almost absent or very rarely present in *H. pinnata* and *H. nilgerriensis*. Leaf divisions are unequal in *H. capense* and *H. nilgerriensis* while in *H. pinnata* this feature is not very stable and therefore in some leaves of the latter the divisions may be uniform and in others they may be unequal. Leaf divisions in *H. nilgerriensis* are comparatively smaller and narrower than in the other two species, but, at the same distance from the apex the leaf divisions are usually 7-9 cells wide in *H. nilgerriensis* and 4-5 and 5-6 cells wide in *H. capense* and *H. pinnata* respectively. Similarly the superimposed apical cells in leaf divisions also differ in the south Indian species. These are 2-3 in *H. nilgerriensis* and 2-4 and 4-10 in *H. pinnata* and *H. capense* respectively. The slime papillae occur in all the three south Indian species but they are very rare in *H. capense* and rather common in *H. pinnata*. The vitta is distinct and well defined in all the three species.

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* Not seen in original.